

# EFFECTIVE RSI VALUES

Government  
Publications

## A better way to compare energy efficiency

February 1997

### THE EFFECTIVE RSI VALUE (EFFECTIVE R-VALUE) IS A MORE ACCURATE WAY TO INDICATE THE ENERGY EFFICIENCY OF YOUR WALL, ROOF OR FLOOR SYSTEM

**N**ew building products, systems, and non-traditional framing materials demand a new approach to measure and compare energy efficiency. Used by the R-2000 Home Program and many leading-edge builders, Effective RSI values (the metric equivalent of Effective R-values) are becoming the accepted way to represent the energy efficiency of a wall, roof or floor system. The advantages of Effective RSI values led the *1996 National Energy Code for Houses* to use these RSI values to set minimum standards for energy efficiency.

Using the Energy Code and Effective RSI values, builders can easily answer questions such as "Is a 2 x 4" wall with rigid insulating sheathing more efficient than a 2 x 6" wall with wood sheathing?" or "How much insulation do I have to add to compensate for the thermal bridging when I switch from wood to steel studs?"

#### RSI VS EFFECTIVE RSI

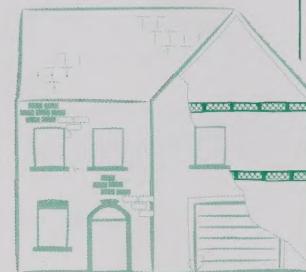
RSI value is a term familiar to most builders. It is a number that indicates the resistance to heat loss through a material. The higher the RSI value, the better the insulating properties of the material.

A typical insulation batt used in a wood frame wall, for example, would have an RSI value of 3.52 (R-20). Today, many builders might describe the wall as being an R-20 wall. But this does not take into account the significant impact of the framing, sheathing, or interior and exterior finishes on the energy efficiency performance.

#### Effective RSI has many advantages

Using Effective RSI to identify the energy efficiency of the entire system, not just the insulation, has three important advantages:

- Effective RSI tells you the real insulating value of a wall, floor or roof system.
- Effective RSI allows you to compare innovative building systems with traditional construction methods.
- Effective RSI lets you choose the most affordable combination of materials to obtain the target energy efficiency. It is the energy efficiency that counts; the door is wide open as to how you attain it.



Heat loss through framing members is generally greater than through the insulation, because the RSI value of the wood is much lower than the RSI of the insulation. The more wood there is in the wall, the greater the heat loss. To say the whole wall system has an RSI value of 3.52 (R-20) is simply not accurate.

#### A SIGNIFICANT DIFFERENCE

Wood framing can make up anywhere from 7% of a system's structure (in a roof with trusses @ 600 mm, or 24" o.c.) to 19% of the structure (in an above ground exterior wall). A typical 2 x 6" wood stud has an RSI value of 1.134 (R-6.4), much lower than the RSI 3.52 (R-20) value for the insulation around it.

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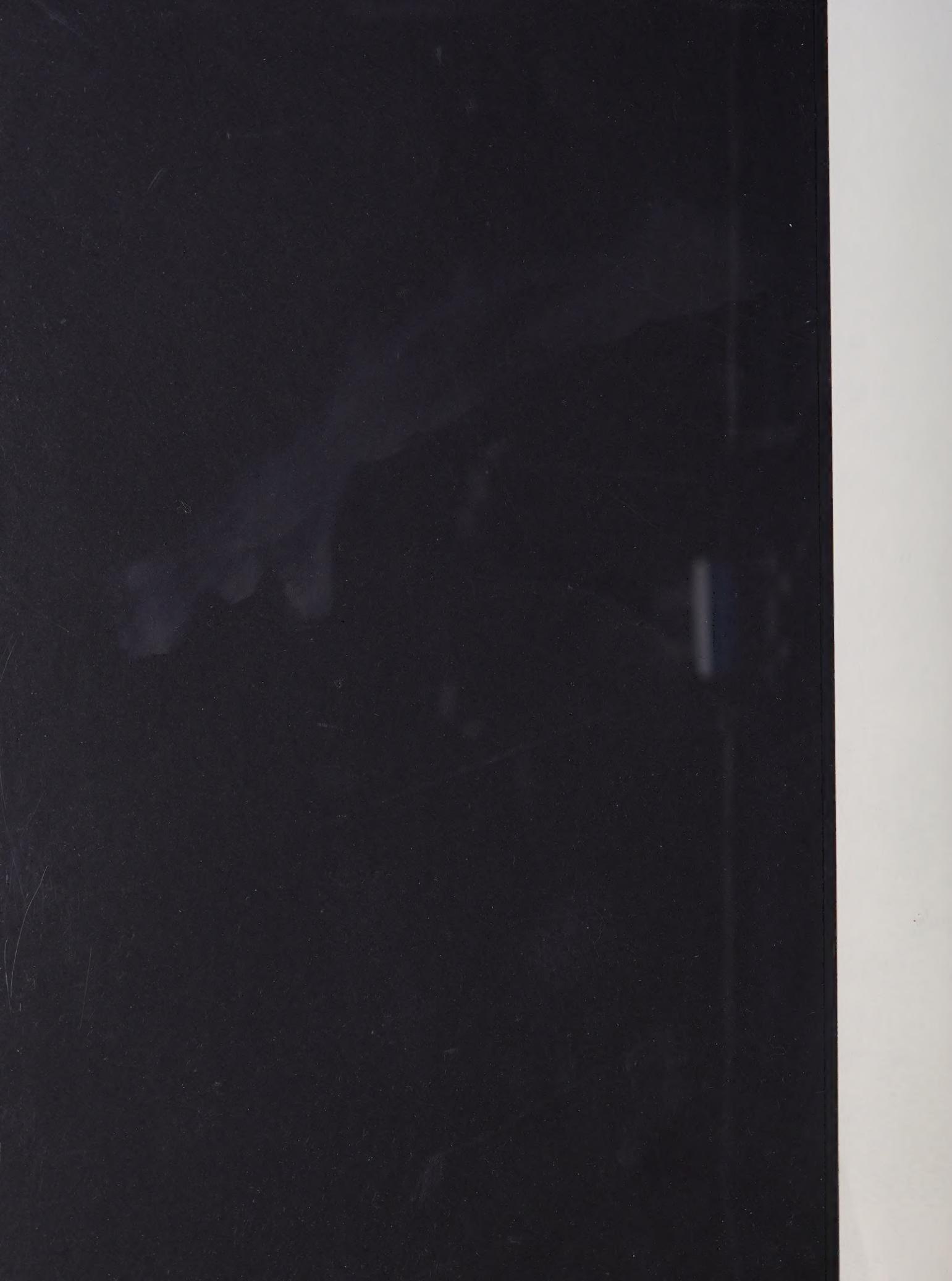
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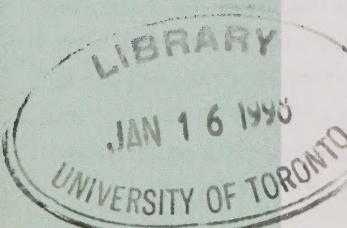
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**Conversion Factors:**  
*R* to *RSI* and back again

*RSI* is the metric equivalent of *R*.  
To convert:

$$RSI \times 5.678 = R$$
$$R \times 0.1761 = RSI$$

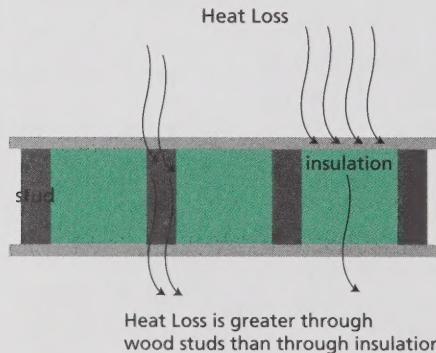
An Effective RSI value, as used by the *National Energy Code for Houses*, accounts for the whole system. This includes not only the insulation and the framing, but also the cladding, sheathing, and the gypsum board or other interior finish.

### EFFECTIVE RSI IS USUALLY LESS THAN THE INSULATION RSI

The Effective RSI value of a system that includes framing material is less than or equal to the insulation RSI value. It is important to understand that the minimum RSI value called for in the Energy Code is not the number on the insulation batt. It is not even the number you get when you add up all the RSI values of the different materials.

The Effective RSI value is in effect an area-weighted average of the thermal resistance through different cross sections of the assembly.

Using the example of a wall system, there is greater heat loss at the studs than there is through the stud space insulation. The studs are acting as a thermal bridge.



In this diagram, each stud forms a thermal bridge. Effective RSI accounts for the thermal bridging, which occurs through the wood studs. Effective RSI averages the heat loss over all components of the wall.

A thermal bridge is an area that allows more heat to escape than the better insulated area around it.

When the Effective RSI value of a system is calculated, the heat loss through the framing is taken into account. The result is that the Effective RSI number for that system is usually less than the RSI value of the cavity insulation.

This different way of indicating the thermal resistance of a system has led some people to incorrectly think that the minimum energy efficiency required by the Energy Code is not as good as what many builders are already doing in their region.

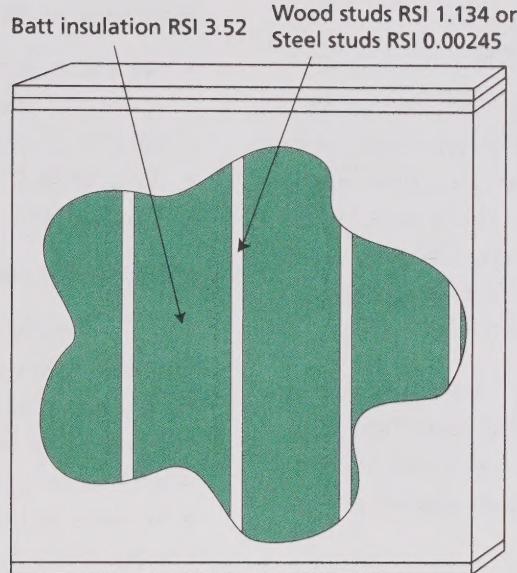
### CALCULATING EFFECTIVE RSI

Each component of the assembly, such as insulation, sheathing, or exterior and interior finishes, has a separate insulating value. This individual component value is called the Nominal RSI value (Nominal R-value).

The sum of the Nominal RSI values at a cross section through the framing will be less than the sum of the Nominal RSI values at a cross section through the cavity insulation.

#### What is the Effective RSI of this 2 x 6" wall system?

Take, for example, a typical Southern Ontario or Atlantic Canada exterior wall assembly. The wall has RSI 3.52 (R-20) stud space insulation, but the insulation only accounts for 81% of the total area of the wall system. The rest is made up of 38 x 140 mm wood studs @ 406 mm o.c. (2 x 6" @ 16" o.c.) and top and bottom plates with a much lower Nominal RSI value of 1.134 (R-6.4).



*The real ability of this wall system to stop heat loss is not RSI 3.52 — but you may be looking at it that way.*

#### Impacts of not using Effective RSI to measure energy efficiency

- inaccurate sizing of heating system
- underestimated heating and cooling costs
- misleading system performance claims

#### Example #1: A typical wall system's nominal RSI values.

System Component	RSI where the insulation is	RSI where the studs are
Outdoor air film	0.030	0.030
Aluminum siding	0.110	0.110
Sheathing paper	0.011	0.011
11 mm (3/8") sheathing	0.121	0.121
Batt insulation	3.34*	—
2 x 6" wood studs	—	1.134
Poly air-vapour barrier	—	—
13 mm (1/2") gypsum board	0.079	0.079
Indoor air film	0.120	0.120
<b>TOTAL Nominal RSI values</b>	<b>3.811</b>	<b>1.605</b>

\* Insulation value of RSI 3.52 (R-20) insulation is reduced when it is compressed to fit into a 5.5" stud cavity. The actual RSI value is 3.34 (R-19).

The 81% of the wall that is insulated has a Nominal RSI value of 3.811.

The 19% of the wall area that is wood has a Nominal RSI of 1.605.

To find the Effective RSI value, use this calculation:

$$\text{Effective RSI value} =$$

$$\frac{100}{\frac{\% \text{ area with framing}}{\text{RSI through framing}} + \frac{\% \text{ area with insulation}}{\text{RSI through insulation}}}$$

therefore, Effective RSI value =

$$\frac{100}{\frac{19}{1.605} + \frac{81}{3.811}} = 3.02$$

This example shows how the Effective RSI values called for in the Energy Code are different from the insulation RSI. In this typical wall assembly:

- batt insulation Nominal RSI = 3.52 (R-20)
- sum of the Nominal RSIs = 3.81 (R-21.6)
- Effective RSI of system = 3.02 (R-17)

Is it really necessary to calculate the Effective RSI value this way? Not at all. *The National Energy Code for Houses* has reference tables that simplify the process.

Use the same wall assembly as above, but replace the wood studs with 41 x 152 mm steel studs. The appropriate Energy Code table gives you the Effective RSI for this system.

The wall assembly now has a very different effective insulating value:

- batt insulation Nominal RSI = 3.52 (R-20)
- sum of the Nominal RSIs = 3.81 (R-21.6)
- Effective RSI of system = 1.82 (R-10.3)

The National Energy Code for Houses divides Canada into 34 regions to account for differences in energy prices and climate. For example, British Columbia decided upon 5 regions, Quebec identified 3 regions, but Saskatchewan, Nova Scotia, P.E.I., and New Brunswick did not divide their provinces into regions.

A table for each region or province can be found in Appendix A of the Energy Code. Each table describes the minimum Effective RSI values for wall, roof, and exposed floor systems. In addition, some provinces chose to have separate Effective RSI values for different fuel categories. This means that, in a particular region, minimum Effective RSI values are higher for more expensive energy sources, as it is cost-effective to include more insulation.

## DETERMINING EQUIVALENCIES

The tables in the Energy Code are useful for finding out what different combinations of materials will give you the same energy efficiency performance. This is useful when material prices change and a builder wants to identify acceptable construction options for wall, roof, or exposed floor systems.

Effective RSI values put different building systems on a level playing field. They let a builder select the least costly construction while still achieving the equivalent energy efficiency performance.

### Example #2: Steel vs. wood stud wall system for a gas-heated home in B.C.'s Lower Mainland

Appendix A of the *National Energy Code for Houses* states that wall systems in a gas-heated home in B.C.'s lower mainland must have a minimum RSI value of 2.00 (R-11.4). A builder can choose from several combinations of materials to meet that target. Here are two examples which use the tables in Appendix B of the Energy Code:

### Wall System #1

- 38 x 89 mm wood studs @ 406 mm (2 x 4" wood studs @ 16" o.c.)
- RSI 2.11 (R-12) cavity insulation
- 11 mm (3/8") fiberboard sheathing
- Stucco exterior finish

**Effective RSI value = 2.08 (R-12)**

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### Wall System #2

- 41 x 92 mm steel studs @ 406 mm (1.6 x 3.5" steel studs @ 16" o.c.)
- RSI 2.11 (R-12) cavity insulation
- RSI 0.88 (R-5) insulated sheathing
- Stucco exterior finish

**Effective RSI value = 2.09 (R-12)**

There are many other combinations of materials that would also give you the equivalent Effective RSI value. The builder can work with building product suppliers to select the most cost-effective combination that meets or exceeds the minimum required energy efficiency.

### TO SUM UP . . .

Effective RSI values are an accurate measure of energy efficiency for all types of systems. They make it easier to compare new products and construction methods, and they give the builder more flexibility to respond to construction material price fluctuations.

Either reference tables or a new easy-to-use software program called **HOUSTRAD** are available to help identify construction options.

For more information, please contact:

Energy Code Support Program  
Energy Efficiency Branch  
Natural Resources Canada  
580 Booth Street  
Ottawa, ON K1A 0E4  
fax: (613) 943-1590

or visit our Internet site at  
<http://eeb-dee.nrcan.gc.ca>

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